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Predictors of Health-Related Quality of Life in Adolescents with Tetralogy of Fallot

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Abstract

Objective—To assess health-related quality of life (HRQoL) of adolescents with repaired tetralogy of Fallot (TOF) and whether impairments in HRQoL domains are associated with neurocognitive and medical factors.

Study design—Parents of subjects with TOF and healthy referents 13–16 years of age completed the Child Health Questionnaire (CHQ)-Parent Form 50, generating psychosocial (PsS) and physical (PhS) health summary scores. Adolescents completed the CHQ-Child Form 87 and concurrent in-person neurocognitive testing. We analyzed relationships of PsS and PhS scores with neurocognitive performance and medical factors.

Results—Compared with referents (n=85), adolescents with TOF without a genetic diagnosis (n=66) had lower PsS (50.9±9.4 vs. 57.2±4.2, $P<0.001$) and PhS scores (49.4±9.5 vs. 55.8±4.9; $P<0.001$). Compared with a normative sample, these adolescents with TOF had similar PsS scores ($P=0.52$), but significantly lower PhS scores ($P=0.01$). Within adolescents with TOF without genetic disorders, lower PsS scores were highly associated with worse neurocognitive measures, particularly the parent-reported Behavior Rating Inventory of Executive Function composite ($r=-0.66$, $P<0.001$) and Parent Connors' attention deficit-hyperactivity disorder (ADHD) Index T

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score ($r=-0.54$, $P<0.001$), whereas associations of PhS scores with neurocognitive measures were weaker.

Conclusions—Psychosocial health status in adolescents with TOF without genetic disorders was worse than in healthy referents without risk factors for brain injury, but similar to a normative sample; physical health status was worse in these adolescents than in either comparison group. Within these subjects with TOF, worse psychosocial health status was most highly associated with concurrent executive dysfunction and ADHD. Optimizing HRQoL constitutes another indication for attention to neurodevelopment in children with congenital heart disease.

Keywords

congenital heart disease; neurodevelopmental outcomes; attention deficit-hyperactivity disorder; executive dysfunction

Tetralogy of Fallot (TOF) is the most common cause of cyanotic congenital heart disease (CHD), comprising 8–10% of all congenital cardiac lesions.^{1–3} Survival of patients with TOF ranges from 80–90% at thirty year follow-up,^{4, 5} highlighting the importance of their general functioning and health-related quality of life (HRQoL). Furthermore, the population with CHD is at high risk for neurologic and developmental disabilities.^{6, 7} To our knowledge, no studies have examined the relationship between neurocognitive function and HRQoL in subjects with repaired TOF, particularly those without velo-cardio-facial syndrome or other genetic disorders.

In the present study, we sought to determine the psychosocial and physical health status of adolescents with repaired TOF and to explore whether impairments in these domains are associated with neurocognitive and medical factors. We also sought to compare HRQoL measures of this cohort with those of locally-recruited healthy adolescent referents and a published normative sample. Finally, we compared parent- and adolescent-reported measures of HRQoL within the TOF cohort.

METHODS

Subjects were enrolled between June 2004 and September 2007 in a single-center, cross-sectional study of adolescents with TOF who had undergone repair, as previously described.⁸ Briefly, the study evaluated subjects with respect to academic achievement, cognition, behavior, and brain structure and function assessed by magnetic resonance imaging. Eligibility criteria included ages 13 through 16 years at time of enrollment, diagnosis of TOF with or without pulmonary atresia, and most recent cardiac operation at least 3 months before neurocognitive testing. Exclusion criteria included disorders that would prevent successful completion of planned study testing (i.e., pacemaker, metal implants), trisomy 21, and primary caregiver with lack of reading fluency in English. Subjects with pre-existing neurologic abnormalities or known 22q11 microdeletion were not excluded. Subjects with TOF were classified as having a genetic diagnosis based upon either medical history of a genetic/phenotypic syndrome consisting of multiple anomalies or a finding of a genetic disorder on formal diagnostic testing as previously reported.⁸ Subjects with TOF were otherwise assumed to have no known genetic diagnosis.

In addition to a published normative sample,⁹ a group of normally-developing, local healthy referent subjects ages 13 through 16 years was also recruited.⁸ Exclusion criteria for this group are described in the National Institutes of Health study of normal brain development.¹⁰ These subjects had no known risk factors for brain injury and hence reflect optimal neurocognitive performance in a healthy population.⁸ The Institutional Review Board approved this protocol. Informed consent was obtained from parents or guardians, and assent from all subjects.

The Child Health Questionnaire (CHQ) is a validated, comprehensive tool providing a qualitative assessment of psychosocial and physical functioning across multiple domains in children ages 5 to 18 years.¹¹ Both the parent and child assessment forms, CHQ-PF50 and CHQ-CF87 respectively, can be self-administered. The CHQ-PF50 includes 50 questions and generates psychosocial (PsS) and physical (PhS) health summary scores, derived as a weighted average of 10 subscale scores. PsS scores are primarily determined by the mental health, role/social-emotional/behavioral, behavior, and self-esteem subscales. PhS scores are primarily determined by the physical functioning, role/social-physical, bodily pain, and general health perceptions subscales. The parent emotional impact and parent time impact subscales contribute to each summary score. Higher summary scores indicate better psychosocial and physical health status. The CHQ-CF87 includes 87 questions and generates subscale scores corresponding to those of the CHQ-PF50 with the exception of parent impact subscales. Additionally, the role/social-emotional/behavioral subscale of the CHQ-PF50 is separated into role/social-emotional and role/social-behavioral subscales on the CHQ-CF87. The CHQ-CF87 does not generate summary scores.¹¹

As previously described,⁸ an extensive battery of neurocognitive testing was performed. Administered tests included the Wechsler Intelligence Scale for Children-Fourth Edition (WISC);¹² Wechsler Individual Achievement Test-Second Edition (WIAT);¹³ Children's Memory Scale;¹⁴ Delis-Kaplan Executive Function System (D-KEFS);^{8, 15} parent, child, and teacher versions of the Behavior Rating Inventory of Executive Function;^{16, 17} the Test of Visual-Perceptual Skills (non-motor) (Upper Level)-Revised (TVPS);^{8, 18} the Autism Spectrum Quotient;¹⁹ and adolescent and parent versions of the Conners' CADS-IV rating scale.²⁰

Statistical Analyses

The study's primary focus was on the relationships of PsS and PhS scores in subjects with TOF with: (1) performance on concurrent neurocognitive measures, analyzed using partial Pearson correlation; and (2) medical factors, analyzed using multivariable linear regression. These analyses were adjusted for concurrent family social status, measured with the Hollingshead Four Factor Index of Social Status.²¹ Subjects with TOF were compared with healthy local referents with respect to sociodemographic and medical history characteristics using two-sample t-tests for continuous variables and Fisher exact tests for categorical variables. Using linear regression adjusting for social status, we compared PsS and PhS summary and subscale scores of: (1) Subjects with TOF vs. referents; (2) subjects with TOF with vs. without a genetic diagnosis; and (3) subjects with TOF with vs. without concurrent cardiac symptoms. CHQ-PF50 summary and subscale scores of subjects with TOF were

compared with published normative data¹¹ using two-sample t-tests. For the CHQ-PF50, normative data for the 13-15 year age group were used to provide the closest age-matched comparison. Parent and child subscale scores of subjects with TOF were compared using paired-sample t-tests.

Univariate analyses identified factors associated with PsS and PhS scores of subjects with TOF without a genetic diagnosis. Sociodemographic characteristics evaluated as predictors were sex, race/ethnicity (non-Hispanic Caucasian vs. other), and age at assessment. Predictors from operative and medical history were birth weight; gestational age; diagnosis of pulmonary atresia; age at initial operation; first operation being an open heart procedure; deep hypothermic circulatory arrest and total support durations at first operation; number of operative complications at first operation; total number of operations, open operations, operative complications, catheterizations and catheterization complications, and neurological event occurrence. Neurological events were defined as seizure, stroke, choreoathetosis, or meningitis. Predictors associated with PsS or PhS scores at a level of $P < 0.15$ were considered for stepwise backward regression in which $P < 0.05$ served as the significance criterion for independent risk factors while adjusting for family social status. Robust regression methods (via MM-estimation using PROC ROBUSTREG in SAS) were used to reduce any undue influence of outlying or high leverage observations in identifying these factors.²² Analyses were generated using SAS (v. 9.3, SAS Institute, Cary, NC) and STATA (v. 12, StataCorp, College Station, TX).

RESULTS

Sociodemographic and medical characteristics of subjects with TOF in this cohort ($n=91$) have been previously described.⁸ Among subjects with TOF whose parent completed the CHQ-PF50 ($n=88$), 55% were male, 89% were non-Hispanic Caucasian, 25% had a diagnosed genetic or phenotypic disorder, and 28% had pulmonary atresia. Most subjects (67%) were in New York Heart Association (NYHA) Class I, 30% in Class II, and the remaining 3% were Class III, whereas 96% of healthy local referents ($n=85$) were in NYHA Class I and the remaining 4% were Class II. In subjects with TOF, reported cardiac symptoms included exertional dyspnea 32%, general fatigue 25%, exercise intolerance 25%, chest pain 23%, palpitations 19%, dizziness 17%, dyspnea at rest 5%, orthopnea 5%, syncope 3%, and swelling 2%.⁸ Referent subjects, compared with those with TOF, had higher birth weight (3.5 ± 0.6 kg vs. 3.2 ± 0.6 kg, $P < 0.001$), had higher social status (54 ± 9 vs. 49 ± 12 , $P = 0.005$), and were older (15.2 ± 1.1 y vs. 14.6 ± 1.2 y, $P < 0.001$), but the groups did not differ in gestational age, sex, or race.

After adjusting for social status, subjects with TOF with ($n=22$) vs. without ($n=66$) a genetic diagnosis had significantly lower PsS scores (41.6 ± 12.2 vs. 50.9 ± 9.4 , $P < 0.001$) and PhS scores (40.4 ± 16.4 vs. 49.4 ± 9.5 , $P = 0.002$). Because the presence of a known genetic diagnosis was such a strong predictor of both HRQoL and neurocognitive outcomes,⁸ further analyses focused on the relationships of only subjects with TOF, without a genetic diagnosis. Compared with the healthy local referent group, subjects with TOF without a genetic diagnosis had significantly lower PsS and PhS scores as well as lower scores on most subscales after adjusting for social status (Table I). Compared with the normative

sample ($n=96$),¹¹ subjects with TOF without a genetic diagnosis had similar PsS scores but significantly lower PhS scores.

In univariate analyses of subjects with TOF without a genetic diagnosis, lower PsS scores were significantly associated with first operation being an open heart procedure rather than a shunt ($P=0.006$), longer deep hypothermic circulatory arrest and total support durations at first operation ($P<0.001$ for both), occurrence of operative complications both at first operation and across all operations ($P=0.002$ and $P=0.02$, respectively), and any neurologic event ($P<0.001$).

After adjusting for social status, independent risk factors of lower PsS scores among subjects with TOF without a genetic diagnosis were longer total support duration and the occurrence of operative complications at first operation (Table II). In analyses exploring the relationship of PsS scores with concurrent cardiac status, adjusting for social status, lower PsS scores were associated with the presence of reported symptoms of dyspnea at rest ($P=0.009$).

In univariate analyses of subjects with TOF without a genetic diagnosis, lower PhS scores were significantly associated with pulmonary atresia ($P=0.002$), more than one operation (vs. one; $P<0.001$), two or more open operations (vs. zero/one; $P<0.001$), more than one cardiac catheterization (vs. one; $P=0.003$), and occurrence of catheterization complications ($P=0.001$). However, PhS scores were not significantly associated with intraoperative variables.

After adjusting for social status, the only independent risk factor for lower PhS scores among subjects with TOF without a genetic diagnosis was a history of more than one operation (Table II). In analyses exploring the relationship of PhS scores with concurrent cardiac status, adjusting for social status, lower PhS scores were associated with worse NYHA class ($P=0.04$) and reported symptoms of exertional dyspnea ($P=0.03$), general fatigue ($P<0.001$), exercise intolerance ($P=0.049$), palpitations ($P=0.01$), dyspnea at rest ($P=0.04$), orthopnea ($P=0.004$), and syncope ($P=0.046$).

Table III summarizes the partial Pearson correlation coefficients, adjusting for social status, of PsS and PhS scores with results of concurrent neurocognitive testing in subjects with TOF without a genetic diagnosis. Lower PsS scores were associated with worse executive function as assessed by the parent-reported Behavior Rating Inventory of Executive Function ($r=-0.66$, $P<0.001$) and the D-KEFS summary score ($r=0.25$, $P=0.04$); attention deficit-hyperactivity disorder (ADHD), as measured by the Parent Conners' ADHD Index T score ($r=-0.54$, $P<0.001$); lower Full-Scale IQ on the WISC ($r=0.32$, $P=0.01$); lower Math Composite on the WIAT ($r=0.39$, $P=0.001$); worse performance on the Autism Spectrum Quotient ($r=-0.35$, $P=0.006$); and worse visual-spatial function measured using the TVPS summary score ($r=0.39$, $P=0.001$).

We found fewer strong associations between PhS scores and neurocognitive testing results. Lower PhS scores were associated with worse executive function as assessed by the D-KEFS summary score ($r=0.28$, $P=0.03$); lower Full-Scale IQ on the WISC ($r=0.25$, $P=0.04$);

lower Math Composite on the WIAT ($r=0.30$, $P=0.01$); and worse visual-spatial function measured using the TVPS summary score ($r=0.26$, $P=0.03$).

Subjects with TOF without a genetic diagnosis scored themselves significantly worse than healthy referent subjects on the physical functioning, role/social-emotional, behavior, and general health perceptions subscales after adjusting for social status (Table IV). Compared with their parents, adolescents with TOF without a genetic diagnosis rated themselves as better in self-esteem and general health perceptions, but worse in bodily pain and mental health subscales.

DISCUSSION

Worse psychosocial health in our sample was strongly associated with concurrent poorer executive function and ADHD. Executive dysfunction has been reported in children after cardiac surgery for two-ventricle and single-ventricle defects, including 13% of subjects with repaired TOF without genetic defects.²³ Impairments in executive function and attention were present in children with repaired D-transposition of the great arteries, and worse performance on neurocognitive testing was associated with lower psychosocial HRQoL.^{24, 25} Deficits in attention have also been described in children and adults with CHD,^{26–29} including those with repaired TOF in whom deficits were associated with lower self-esteem.²⁶ The relationship between neurocognitive disabilities and HRQoL in subjects with congenital cardiac defects is consistent with literature in those with non-cardiac disorders. For example, executive dysfunction predicts worse HRQoL in children with history of arterial ischemic stroke,³⁰ intracranial tumor,³¹ and epilepsy.^{32, 33} Children with ADHD consistently demonstrate a pattern of impaired psychosocial function on the CHQ-PF50.^{11,34–36} Longitudinal data support improvement in HRQoL when ADHD symptoms are improved by pharmacologic intervention;^{34–36} of note, data suggest pharmacologic therapy is well-tolerated in children with CHD.^{37, 38} Taken together, these data suggest the identification and treatment of neurocognitive disabilities may provide an avenue for improving HRQoL in children with CHD.

Our findings that adolescents with TOF have lower psychosocial and physical health status than healthy referents is in agreement with a recent cross-sectional analysis, in which adolescents with CHD scored worse than controls on a generic HRQoL assessment, regardless of heart defect.³⁹ Additionally, impaired physical health status has been reported in adults with repaired TOF using the 36-item Short Form questionnaire.^{26, 40, 41} These studies in adults did not consider factors in the early medical course and subject symptoms in detail. However, reduced right ventricular ejection fraction and echocardiographic indices of left ventricular diastolic dysfunction predicted worse physical health component summary scores. In addition, right ventricular systolic and diastolic dysfunction have been associated with greater patient symptoms and NYHA class.⁴² In adults with CHD, NYHA class has been weakly correlated with perceived quality of life on the Satisfaction With Life Scale.⁴³ Our finding that physical health status was associated with number of operations and concurrent symptoms in TOF is consistent with the relationship between physical health status and overall disease burden in a variety of other disease processes.^{44–46}

Adolescents in our cohort scored themselves as having better overall self-esteem and general health than did their parents, similar to findings in earlier HRQoL assessments in other subjects with repaired TOF,⁴⁷ Fontan subjects,⁴⁸ and adolescents with implantable cardioverter-defibrillators⁴⁹ and non-cardiac diseases.^{45, 50, 51} This pattern may reflect a beneficial adaptation to chronic disease and its associated impairments. HRQoL instruments measure the quality of life at a given point in time, and parents might be projecting their concerns about future problems unrelated to their children's current self-esteem or general health. Conversely, adolescents may not recall their early medical and operative course that heightened parental anxiety so they may not yet share parental concern for obstacles they may face as adults with pre-existing medical and cognitive issues. For example, subjects with CHD achieve a lower maximal educational level than the national average and report higher rates of unemployment or part-time employment.^{52, 53} Many adults with repaired TOF continue to live with their families²⁶ and fewer adult CHD subjects were in relationships than controls in one study.⁵³ With pregnancy, CHD patients may be at increased risk for arrhythmia or even death.⁵⁴ Adults with CHD are more likely to be denied life insurance or a mortgage regardless of disease severity.⁵⁵ Thus, concordance between subject and parental perception of QOL might be predicted to increase as adolescents with TOF enter adulthood and accumulate life experiences.

Our study should be interpreted in view of certain limitations. First, our healthy local referents had better neurodevelopmental outcomes than the general population;⁸ however, their outcomes define a benchmark that patients with CHD and their care providers strive to achieve. The primary analyses focused on parental rather than adolescent report of HRQoL because the CHQ-CF87 self-report has no summary scores. Moreover, there was not a suitable published U.S. normative sample for the CHQ-CF87. Thus, we only compared the CHQ-CF87 subscale scores of adolescents with TOF with those of the healthy referent group. Subjects were recruited from a single center, potentially limiting generalizability. Most but not all subjects with TOF without a genetic diagnosis (70%) had undergone genetic evaluations; moreover, some patients may have had not-yet-discovered genetic abnormalities associated with both TOF and neurocognitive disability. We used a generic rather than disease-specific HRQoL instrument. Cardiac-specific instruments such as the PCQLI⁵⁶ or PedsQL⁵⁷ may have provided additional dimensions to the analyses. Finally, our cross-sectional study relied on medical record review for historical medical data and did not include objective concurrent cardiologic evaluation, such as exercise testing.

Psychosocial health status in adolescents with repaired TOF without a known genetic diagnosis is worse than in adolescents without risk factors for brain injury, but similar to a normative sample; physical health status in subjects with TOF is worse compared with both groups. Whereas lower physical health status was related to early medical and perioperative variables, worse psychosocial health was most highly associated with concurrent neurocognitive function, especially executive dysfunction and ADHD symptomatology. Identification of impairment in these domains could provide the opportunity to improve HRQoL through targeted interventions, with benefits extending into adulthood.

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Abbreviations

ADHD	attention deficit-hyperactivity disorder
CHD	congenital heart disease
CHQ	Child Health Questionnaire
CHQ-PF50	Child Health Questionnaire-Parent Form 50
CHQ-CF87	Child Health Questionnaire-Child Form 87
D-KEFS	Delis-Kaplan Executive Function System
HRQoL	health-related quality of life
NYHA	New York Heart Association
PhS	physical health summary
PsS	psychosocial health summary
TVPS	Test of Visual-Perceptual Skills
TOF	tetralogy of Fallot
WIAT	Wechsler Individual Achievement Test-Second Edition
WISC	Wechsler Intelligence Scale for Children-Fourth Edition

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Table 1

Comparisons of PsS and PhS scores and CHQ-PF50 subscales for TOF adolescents without genetic diagnosis, referents, and CHQ-PF50 13-15y normative sample

Variable	TOF without genetic diagnosis (n=66)	Referent (n=85)	CHQ-PF50 normative sample (n=96)	P value ^a comparing TOF without genetic diagnosis to referent	P value ^b comparing TOF without genetic diagnosis to normative sample
	Mean ± SD				
PsS score	50.9 ± 9.4	57.2 ± 4.2	50.0 ± 8.9	<0.001	0.52
PhS score	49.4 ± 9.5	55.8 ± 4.9	53.0 ± 8.8	<0.001	0.01
Subscales					
Physical functioning	88.1 ± 19.2	97.5 ± 8.4	96.5 ± 12.8	<0.001	0.001
Role/social-emotional/behavioral	90.2 ± 22.4	100.0 ± 0.0	92.3 ± 20.7	<0.001	0.55
Role/social-physical	95.5 ± 15.9	99.4 ± 4.0	92.1 ± 21.6	0.09	0.28
Bodily pain	87.4 ± 18.0	86.4 ± 16.2	81.8 ± 17.9	0.84	0.052
Behavior	78.2 ± 17.7	90.4 ± 9.1	76.3 ± 17.6	<0.001	0.50
Mental health	80.3 ± 12.5	85.8 ± 7.2	76.6 ± 12.9	0.001	0.07
Self-esteem	77.3 ± 16.7	84.1 ± 15.2	76.8 ± 15.1	0.02	0.85
General health perceptions	57.3 ± 14.7	86.6 ± 12.4	72.8 ± 14.6	<0.001	<0.001
Parent emotional impact	64.8 ± 24.3	88.6 ± 12.0	77.3 ± 21.4	<0.001	<0.001
Parent time impact	90.1 ± 17.9	96.5 ± 11.9	85.4 ± 20.9	0.04	0.14

^a P values were determined by linear regression with adjustment for concurrent family social status as defined by the Hollingshead Four Factor Index of Social Status, with higher scores indicating higher social status.

^b P values were determined by two-sample t-tests.

Independent risk factors of PsS and PhS scores for TOF adolescents without genetic diagnosis, adjusting for concurrent family social status

Table II

Variable	PsS (n=60) ^a	PhS (n=66)
<i>β</i> -estimate [95% CI] (<i>P</i> value)		
Total support duration at first operation (per min)	-0.05 [-0.09, -0.02] (0.001)	
One or more operative complication at first operation (vs. zero)	-4.8 [-7.9, -1.7] (0.003)	
Two or more total operations (vs. one)		-6.1 [-9.0, -3.2] (<0.001)
Family social status ^b (per point)	0.12 [-0.02, 0.26] (0.10)	0.07 [-0.06, 0.20] (0.28)

^a Sample size reduced in multivariable models due to missing values for total support time at first operation (n=5) or number of operative complications at first operation (n=1).

^b Score on Hollingshead Four Factor Index of Social Status, with higher scores indicating higher social status.

Table III

Relationships of PsS and PhS scores with concurrent neurocognitive testing for TOF adolescents without genetic diagnosis (n=66)

Variable	PsS	PhS
	Partial Pearson <i>r</i>	(<i>P</i> value)
WISC		
Full-Scale IQ	0.32 (0.01)	0.25 (0.04)
Verbal Comprehension	0.29 (0.02)	0.27 (0.03)
Perceptual Reasoning	0.26 (0.04)	0.21 (0.09)
Working Memory	0.27 (0.03)	0.19 (0.13)
Processing Speed	0.25 (0.04)	0.21 (0.09)
WIAT		
Reading Composite	0.21 (0.09)	0.24 (0.06)
Math Composite	0.39 (0.001)	0.30 (0.01)
Children's Memory Scale General Memory Index	0.24 (0.06)	0.18 (0.15)
D-KEFS Summary Score	0.25 (0.04)	0.28 (0.03)
Behavior Rating Inventory of Executive Function		
Self-Report	-0.46 (<0.001)	-0.21 (0.11)
Parent	-0.66 (<0.001)	0.05 (0.72)
Teacher	-0.40 (0.008)	-0.22 (0.16)
TVPS Summary Score	0.39 (0.001)	0.26 (0.03)
Autism Spectrum Quotient	-0.35 (0.006)	0.19 (0.14)
Adolescent Conners' ADHD Index T Score	-0.32 (0.01)	-0.14 (0.30)
Parent Conners' ADHD Index T Score	-0.54 (<0.001)	0.03 (0.79)

P values were determined by partial Pearson correlation with adjustment for concurrent family social status as defined by the Hollingshead Four Factor Index of Social Status, with higher scores indicating higher social status.

Missing < 10% of outcomes except the Behavior Rating Inventory of Executive Function - Teacher (n=43).

Table IV
Comparisons of CHQ-CF87 subscales for TOF adolescents without genetic diagnosis to referents and to parents

Variable	TOF without genetic diagnosis (n=61)	Referent (n=85)	P value ^a comparing TOF without genetic diagnosis to referent	P value ^b comparing TOF without genetic diagnosis to their parents
Mean ± SD				
Subscales				
Physical functioning	89.9 ± 14.3	96.5 ± 8.3	<0.001	0.89
Role/social-emotional ^c	87.4 ± 20.0	95.3 ± 13.6	0.02	
Role/social-behavioral ^c	90.0 ± 22.3	93.2 ± 17.9	0.58	
Role/social-physical	94.4 ± 15.9	96.2 ± 13.7	0.50	0.40
Bodily pain	80.0 ± 17.0	78.1 ± 20.6	0.58	0.003
Behavior	78.9 ± 15.1	84.8 ± 10.0	0.01	0.93
Mental health	77.2 ± 12.3	78.3 ± 9.4	0.52	0.04
Self-esteem	82.7 ± 15.5	84.7 ± 11.9	0.40	0.04
General health perceptions	71.2 ± 14.2	75.9 ± 14.1	0.046	<0.001

^a P values were determined by linear regression with adjustment for concurrent family social status as defined by the Hollingshead Four Factor Index of Social Status, with higher scores indicating higher social status.

^b P values were determined by paired-sample t-tests.

^c The CHQ-PF50 combines the role/social-emotional and role/social-behavioral subscales, so an equivalent comparison is not available.